Role of Shale Gas under a Clean Energy Standard

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Motivation and objective

- There is still significant uncertainty in shale gas supply from developments in drilling technologies, the US as a potential net exporter of gas, environmental regulations that may restrict shale gas access, etc.

- A Clean Energy Standard (CES) can harness the potential of a shale gas boom
  - Requires the share of electric generation from qualifying “clean sources” to meet a nominal target.
  - Clean energy sources: renewables, nuclear, natural gas (at 50% credit), and coal units with carbon capture and storage (at 90% credit).
  - Nominal CES target increases steadily from 45% in 2012 to 72% by 2039
  - Credit system for generation from clean sources
  - No banking or borrowing allowed

Objective: evaluate and better understand regional incidence impacts of CES under different natural gas supply outlooks and review region cost-effectiveness resulting from implementing CES
NERA’s N_{ew}ERA Model

Sectoral representation

Non-Energy Sectors
- Agriculture
- Industry
  - Energy-Intensive
  - Motor Vehicle
  - All Other
- Transportation
  - Trucking
  - Other Commercial
- Other Commerce & Services

Other Energy Sectors
- Natural Gas
- Crude Oil
- Refined Products

Electricity Sector
- Electricity
  - Unit-Level Representation
  - Technology-Specific
- Coal
  - Detailed Supply Curves
  - 23 Coal Types

Integration:
- Intertemporal Market Equilibria & Consumer Welfare Maximization

Household Choices
- Labor Supply
- Consumption
- Investment

Key Outputs

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<tr>
<th>Macroeconomic (National/Regional)</th>
<th>Primary Energy (National/Regional)</th>
<th>Electricity (National/Regional/Generating Unit)</th>
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<tbody>
<tr>
<td>Welfare</td>
<td>Demand</td>
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<td>GDP, consumption, investment</td>
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<td>Builds, retrofits, retirements</td>
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<td>Output by sector</td>
<td>Production</td>
<td>Load and Dispatch</td>
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Regional representation
CES policy evaluated under different gas supply outlooks

Natural gas supply curves are adopted from AEO 2011:

- Reference
- High/low shale estimated ultimate recovery (EUR)

Each CES policy scenario is compared to its respective baseline
Natural gas prices increase from additional electric sector demand

Natural gas prices increase in all scenarios...

…with demand up in the electric sector and down in the non-electric sectors
Changes in the share of clean energy generation varies by region

**Reference Gas – No CES**

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**Reference Gas – With CES**

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**Winners**: Nuclear and renewables, natural gas (through about 2033)

**Losers**: Coal, natural gas (in the long term) and utilities (decline in sales because of higher electricity prices)
Residential electricity prices increase under the CES policy in all regions, but certain regions fare better than others. Regions that are buyers of CES permits are hit with both increased natural gas prices and the cost of buying permits, which both drive up electricity prices.
CES creates winners and losers, but mostly losers

Regions that are able to add significant quantities of clean generation at relatively lower lower costs fare better than regions with fewer options and higher costs.

Regions that are the most coal intensive fare worse than regions with more diversified generation mixes.
Conclusions

- The CES policy induces higher demand for natural gas (regardless of the supply outlook), however, it also generates higher natural gas prices and electricity prices.

- The CES policy leads to increased demand for natural gas in the electric sector but has negative consequences on the non-electric sector due to the higher natural gas and electricity prices.

- The cost/burden of the CES policy is not shared evenly among different regions and there are regional winners and losers, although the U.S. as a whole suffers economic costs.
Contact Us

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Cheaper Natural Gas Price Induces More Coal Retirements

**Sectoral representation**

Each dot in the map is a unit or a collection of units that are retired at a county level.

Under REF, CES induces 135 GW additional coal retirement.

Under HEUR, CES induces 144 GW additional coal retirement.

The retired coal capacity consists of existing inefficient units that have non-competitive dispatch costs.
Coal generation declines under the CES policy

Electricity Generation Mix for All Scenarios (TWh)

REF
HEUR
LEUR

REF_CES
HEUR_CES
LEUR_CES

COL  GAS  OTH  NUC  CCS  Wnd  Slr  Bio